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## THE EVIDENCE OF OUR SENSES

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# THE EVIDENCE OF "OUR SENSES

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WITH THREE ~~ILLUSTRATIONS~~



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# THE EVIDENCE OF OUR SENSES

## I

### INTRODUCTORY

THROUGHOUT the present discussions it will be assumed that the sense organs of the observer are in all respects normal and adequate. We shall make but little reference to them, and take their work for granted. It is legitimate to study the results of the activities of the organs without describing their structure, and without analysing the physiological processes, for we are seldom aware of the organs themselves when using them. How much would the most keen-sighted of observers learn about his eyes, if he were in the situation of Robinson Crusoe? What we term a person's ears are at best little more than ornaments, for the true ear lies buried away from observation in a mass of hard bone, and performs its work in secret. We hear in ignorance of the structure of the ear and of its method of responding to external stimuli. It is significant of the modesty of our receptive organs that the traditional list of the senses omits the most fundamental of all. Our experience of weight and resistance, the qualities which matter most when dealing with the physical world, depends upon 'receptors' in muscles and tendons and in the membranes of the joints, and the existence of these organs

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was not suspected until the latter part of the nineteenth century. Yet it is upon impulses arising from them that we depend for guidance in manipulating objects. The control of movement depends upon these receptors together with certain organs in the inner ear, and if they cease to function we cannot so much as stand upright. Yet they do not directly reveal their presence. Just as we do not see the spectacle lens through which we read, so the process of perceiving by means of the senses gives little or no knowledge of the organs which render it possible. And as we can discuss the matter which we read without reference to the spectacles, so we can study the evidence of the senses without a detailed study of the sense organs.

The sense organs may be regarded as physical apparatus, responding adequately to physical forces acting upon them, but behind each lies an elaborate system of nervous connexions linking them to the brain. The structure of the brain is too complex for human thought to grasp in any detail. Are we to assume that all this vast assemblage of nervous units is merely passive, and that it maintains a strict neutrality in registering the messages which reach it from the outer world? One important change at least takes place. The sense organs *receive* light waves and sound waves, we *perceive* neither, but see a motor-car and hear its engine. The eye can only report colour spread out in surfaces of varying extent and shape, but more than colour is required to construct a car. This simple example is sufficient to show that it is necessary to divide up the study of sensory experience into sections, and that we can conveniently take up the examination of perception at the point where

the receptors have completed their functions. Then we may ask how far we can trust the data which they have given us to be a valid account of our physical environment.

Walking in London on a very foggy night, the writer saw a long white stick projecting obliquely from the pavement and at once stepped over it. A moment later two questions occurred to him. How came there to be a stick in such a dangerous position, and how had he been able to see it when all else was hidden? On examination the obstruction proved to be a shaft of light emerging from a grating. The mistake which had been made was harmless and amusing, but since other similar mistakes might be more costly it is desirable to understand how it arose.

The eyes must be at once acquitted of any error. They doubtless registered their image faithfully and transmitted the appropriate message to the brain. Their only contribution to the perception of the pseudo stick was to make me aware of a 'long whiteness'. If a luminous stick had really been present they could have told me no more. So the stick which I 'saw' must have come from elsewhere. Its origin is clear. I had in some way supplemented the sensory data, and I was mistaken. The false perception resulted from an activity in which the whole person was involved, and not his eyes alone. But what is true of this false or illusory perception must be equally true of those which we regard as valid. My eyes alone can never see a *stick*, they 'see' only the *long whiteness*. A stick, however, is much more than this, and the visible appearance is compatible with many other and different experiences.

Next let us note that the interpretation of the

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visual impression as a stick was unreflective and instantaneous, involving but little conscious process I did not say, 'This appearance indicates the presence of a stick, and I must step over it lest I stumble' Nor does the reader say, 'This in front of me is a page of printed characters from which I can deduce the words which the writer had in mind' ~~The interpretation~~ The interpretation of the presented fact and the active response thereto are immediate in both cases. The sensory presentation (to use a convenient and traditional word) is apparently so completely fused with its significance as to have become one, and the response is continuous with the perception. In the case of the illusion the interpretation took the form of physical behaviour, and the illusion only occurred because the perceiving organism was engaged in activity. The perception was the response of a *purposing* organism. Had I been engaged in studying the visual phenomena induced by fog, and not intent on walking towards a goal, it is unlikely that the mistake would have arisen. So from this angle also we see that the organism had contributed to its experience, and we shall have to consider the possibility that this is true of all perception. Nor is this the only way in which the percipient (the subject) contributed to his own experience of the object. There was a wide field of vision, as well as other forms of sensory experience, but this one portion was singled out for notice and organized in a particular way. The shaft of light was seen as a dominant object against a dark background, and not as a hole in the fog. Now let the reader reflect on the ludicrous effect of that last phrase. Yet he sees the window as an aperture in the wall and not as something luminous set upon it. Was it so inevitable that the opposite

impression should have been given by the light ?  
Look carefully at this figure



FIG 1

It can be seen as a white figure on a dark ground, or as an interruption of a dark surface. Regard it with a different mental attitude and it becomes a map, showing either an island or a lake. It is not merely that the same neutral and unchanging physical object is susceptible of these different interpretations, it actually *looks* differently according as one or the other is adopted. In such cases it is clear that a particular organization of the parts of the whole experience has been deliberately imposed, and that the experience of the physical fact has been modified by the process. That we can do this at will in simple cases awakens us to the possibility that in all cases the organization depends upon the subject, and a large field is thus opened to investigation.

We have already moved far from the belief that the observer merely mirrors his objective environment. By selection, by organization, and by supplementation, he has largely made the experience which he enjoys, and thus the evidence of the senses, upon



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which all knowledge of the universe ultimately depends is affected by (and perhaps we shall have to say, vitiated by) a subjective factor. The subject's mental constitution makes a contribution to perception as important as that of the objects which affect his sense organs. The study of the principles underlying this subjective contribution is surely as important as that of the physical realm itself. We are led to inquire into the mental laws exhibited in the process of selection and organization of sensory impressions, and to investigate the process which we have termed supplementation. If we confine ourselves to the physical explanation of perception, we find only a total complex field of physical energies affecting our sense organs. How do *we*, as inquisitive human individuals, reach out from that field to the perception of a world of physical objects? We have been led to confront these questions by the consideration of a trivial experience, and our discussions will centre for some time upon simple and unimportant examples, because they are most convenient for experimentation. But the results of this examination can be extended. If in the simplest cases perceptual experience is largely shaped by the mind which perceives, it is certain that the same will be true of more important and complicated instances. Turn from the black and white figure which we have just observed with cool, disinterested curiosity, to an accident as witnessed by one of the victims, and ask what is the validity of his subsequent testimony in a court of law. One is soon tempted to question the validity of any sense knowledge.

One cardinal fact respecting the percipient must be emphasized. He is an active, purposive organism.

His primary aim is to remain alive, to maintain himself uninjured in a changing environment, which assaults or threatens him at every moment. His senses have developed in this struggle. Through them he becomes aware of the material context in which he must move, and of the need for action. He perceives in order to act, and, reciprocally, his will to act governs his perception. He develops a rich system of particular purposes which must be guided by knowledge of the environment, and here again his purpose affects what he perceives. Behind every process of knowing there is one of striving. In technical terms, cognition implies conation, and the two are inseparable, though we have to endeavour to distinguish them for convenience of study. It is impossible to understand perception if we disregard the purposes which lead the subject to perceive. This is fully, if confusedly, realized in ordinary life when we appeal to 'interest' as an explanation of any anomaly of perception.

The main lines of our study are now marked out.

## II

### SELECTION AND ORGANIZATION

ORDINARILY some one part of our perceptual experience stands out sharply from a background which is comparatively confused, and which we largely ignore. In the railway carriage we hear the voice of our companion set against a multiplicity of sound and sights, which affect us to the extent that we are aware of their presence and should notice their cessation or sudden change, but which we otherwise neglect. We do not actively respond to them as we do to the speaker's words, though these unimportant impressions may be considerably more intense physically than the sound of the voice. A selection has been made within the total sensory field, and we describe this fact (and think that we account for it) by saying that we are attending to the person beside us and not to the rattle of the train or the landscape outside. With few exceptions there is always this break-up into a restricted field distinctly apprehended, and a wider field of confused details which affects us only in the mass and dimly. This fact of selection is too familiar to need further illustration, and we proceed to consider the extent of the clearly perceived region, taking first the case of visual apprehension, which offers the best material for experiment.

The human eye is not equally efficient in all parts of its sensory surface (the retina). Only a small area in the centre is capable of furnishing a clearly defined

image It might be thought that this fact sufficiently accounts for the selection in the case of sight, but this is not so When care is taken to place a number of simple objects—clearly written letters will serve—within an area so limited that their images fall entirely within the eye's region of distinct vision, and the group is then exposed for a period so short that the observer has no time to move his eyes, it is found that there is a sharp limit to his capacity to discriminate He can report correctly only four or five of the objects, and these only when he is 'attending', that is, when by a deliberate effort of will he has pre-selected that particular field The number which he can apprehend is termed his *span* of apprehension It varies very little from person to person it cannot be extended by practice, and the most intelligent has no wider span than the most stupid It is an arbitrarily fixed limit, apparently as final and irrational as the colour of the eye If we substitute any other equally simple material the span remains unaltered

But when the letters exposed form a word, the span seems to be considerably increased A word of ten or more letters can be read quite easily We can read four or five short words as readily as the same number of isolated letters, and if the words chosen constitute an intelligible phrase, the number read may be again increased. Since the number of separate characters that we can discriminate is so small, it is evident that in reading a long word there can be no conscious apprehension of all the letters separately The word must be read as a single unit in which the constituents are, in a measure, lost We recognize the whole form without clear consciousness of the letters which compose it. Yet they are

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playing their parts in building up the perception. The outline shape of a word, and in particular the indication given by 'ascenders' and 'descenders', undoubtedly influences our reading of it, but there must be in addition at least some recognition of the several characters, for a word in roman capitals can be read as a unit, although the outline of the word is little more than a rectangle. In any case, we do not read letter by letter, but by words as wholes, the letters being subordinated to the whole, and this is why the unpractised proof-reader overlooks so many errors.

In this manner the span of visual apprehension has been effectively extended by organization of the material. The number of units has not been increased, but they have become richer internally, and more significant. In reading a page of print the eyes do not move steadily along the line, but in sudden jerks without keeping a steady direction, so that the 'point of regard' is now above and now below the line. The angular velocity of the eye's movement is too great to permit a clear vision during the movement, so reading takes place only in the momentary pause. Physiologically as well as psychologically, the eye and the mind can gather very little clearly discriminated material in such a short time, but with practice we can enrich the significance of the reading, and greatly improve the capacity for recognition of words and phrases, even to the point of being able to take in the sense of a complete paragraph in one or two glances.

Yet more than practice is involved. Turn once more to the experiment described above, but let us now take dots as material. We find that if about a dozen are exposed it is much easier for the observer

to reproduce them if they have been arranged in a pattern than when scattered in random order. In this instance organization in itself, apart from familiarity and meaning, appears to be the essential factor. And by this method we make a new discovery. While the span for random material is the same for the dullard as the genius, so soon as any form of organization is introduced the 'genius' has the advantage. The dullard perhaps fails to see the pattern at all, and at best derives less than the full benefit from it. Now tentatively we may suggest that on purely spatial considerations (speaking, as it were, from the point of view of the dots themselves) there can be no real or intrinsic pattern. One arrangement or disarrangement is as good as any other. If this is correct, it follows that the organization must be the work of the observer, the spatial relations between the dots only facilitating or hindering the mind's activity. Then we might conclude that intelligence and the power to organize sensory material were associated, or even that part of what we mean by the term 'intelligence' (a term too hopelessly vague for scientific usage) is the gift of organizing experience. This topic we must postpone.

Similar facts can be discovered with regard to touch. About six isolated impressions can be discriminated in a single act of apprehension. In the sphere of hearing the facts are parallel, but more difficult to state. Simultaneous sounds tend to blend together into one compound sound, and if by selection we single out the components, we can only do so by attending to them one by one in a series. So the span of auditory apprehension must be sought in another direction. If a series of simple sounds (e.g. taps of

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uniform loudness) are presented to an observer who is forbidden to count them, he can recognize groups as being the same or different, provided that the number of taps in a group does not exceed five or six. This, then, is the span in respect to hearing. Is there any phenomenon corresponding to the effective extension of the visual span that results from organization? Yes, rhythm provides the pattern here. As soon as rhythm is introduced into the taps the span is substantially increased. Simple rhythmic groups function as units, and a complex pattern of these may be recognized on repetition. The pattern may be enriched by differences of pitch and tone colour, with further results upon the span. This opens up a wide field of study of great importance for aesthetic theory, but we cannot pursue it here. We have now sufficiently emphasized the importance of organization for effective observation.

To apprehend more fully gives the power to act more adequately, and therefore organization of sensory material is biologically important, and we must inquire into its principles, considering whether it is in any way compulsive, or due only to an arbitrary, perhaps deliberate, intervention of the mind. Turn back to the diagram on p. 5. This is sufficiently simple to fall entirely within the span of apprehension. Yet it divides into figure and ground. We are now using the term 'ground' in a somewhat technical sense which will become clear as we proceed. The ground in the diagram does not fall back into the general dim awareness of the total background which surrounds the object of attention. It is relevant to the figure, as the ticking of the clock (or, in this instance, the rest of the page) is not. The whole diagram is the

object of attention, and all of it is essential to the perception. Yet the distinction is made, and in some respects it is analogous to that between the attended and the unattended. The figure seems more important, it appears to be slightly nearer to the observer, and the ground is less completely discriminated. Lines of division between the mentally clear and the confused are drawn at more than one level, first between the diagram and the rest of the field of consciousness, and then again between the figure and its ground. Puzzle pictures offer excellent illustrations of this. Once the hidden design is detected the rest of the picture, which was formerly 'figure', collapses suddenly into 'ground', though it must still retain some degree of discriminative clearness or the new figure also would disappear. Since the physical object remains unchanged we must ascribe the difference between the two appearances to the mind, and the difference is profound. When Bishop Blougram remarked plausibly enough, 'We called the chess-board white—we call it black', he overlooked the vast difference there is for the observer between white squares on a black ground and black squares on a white ground. In this distinction between figure and ground we have the first principle of mental organization. It is probably closely related to the distinction between attention and non-attention, and, like it, is to some extent controllable. That we can in some cases change the distribution of field and ground shows that it originates with the observer. But it does not follow that it is arbitrary. Not only is it unavoidable that a distinction must be made, but the reader on looking around him will find many instances where the reversal of figure and ground is



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impossible. We are confronted by law, but the law is psychological.

This process of selection and re-selection is still a mystery. Since conscious processes are in some way (we cannot speak more definitely) associated with physiological processes in the brain, the following suggestion may be made. We have remarked that perception is linked with action and that it is always directed by purpose, sometimes vague and general, sometimes highly specific. Conversely, for efficient action the guidance of clear perception is requisite. The purpose of the moment is always concerned with some particular part of the whole environment, and correlated physiological processes are probably more or less limited to certain tracts of the nervous system. Since the amount of physical energy in the brain at any moment is necessarily limited, it is advantageous that it should be concentrated in the parts in action. So it is supposed that energy is partially withdrawn from the remainder of the brain and thus brought to a higher level of intensity in the tracts then operative. The increased vividness of the perception, it is suggested, is related to the increased nervous energy in the appropriate regions of the brain. But the mechanism which brings about this redistribution is unknown, and we are too ignorant of the details of the brain's activities to go farther than a suggestive hypothesis. But we may at least say that if human capacity is limited, as we always assume it to be, it is better that it should be concentrated upon that which matters here and now. Even on the negative side it is useful that we can ignore the irrelevant. The process of attentive selection is as much one of shutting out as of bringing forward.

We must now study more closely that favoured portion of the field of view which we have called the figure. The word has been hitherto applied as a label only, but we shall see that its usual implications can be accepted, since what we perceive has always some degree of pattern or structure. However lacking in arrangement the items presented may be when considered only in their physical character, we tend invariably to perceive them, not as a mere incoherent jumble, but as organized into a whole. This statement is readily tested by simple experiments. Make three dots on paper, setting them fairly close together but not in a straight line. We at once see them as a triangle. This seems so inevitable that we need to remind ourselves that they could lie equally well on a circle, or upon any other figure. Moreover, it was not our intention that they should form any figure at all. Yet the triangularity of the arrangement is as prominent as the individual dots. Now test further by increasing the number of dots, and arranging them in regular order.

This, for example, is a square, and similar results will be found with five and six. But as the number increases it will be found that the character of the pattern changes, and we tend to see an enclosed curved figure. The more numerous the dots the more evident is the pattern and the less obvious the elements which constitute it. We may not know their number and

may fail to appreciate the geometrical relations of each to each, and yet the pattern stands out

The sensory material is thus integrated into unitary wholes, the details being subordinated, though of course essential to the building up of the whole effect. One sees a wall, and that it is a brick wall, without discriminating the bricks. The point to be emphasized here is that in the majority of normal cases we do not construct the apprehension of a whole pattern (or configuration) from the successive apprehension of the parts. On the contrary, we start by perceiving the whole, and subsequently have to search out the details if complete knowledge is required. We see the tiger first as *a* tiger, without putting it together mentally stripe by stripe. And we see it *as striped* without knowing how many stripes it possesses, although more or less of them would make it a very different animal to the observer. It is therefore certain that we cannot identify what we perceive through, or by means of, our senses with the total set of impressions which the senses receive. The results which we observe have been elaborated, and qualities now emerge which could not have been predicted from any list of the sensory elements. Even the spatial arrangement of the elements fails to explain why we see the striped *tiger* more vividly than the stripes which make up its appearance.

There is an invincible propensity to organize and integrate. In the simple cases we have discussed it may be thought that the nature of the object sufficiently accounts for the structure of the perception, but this explanation fails in many cases. Set out a large number of dots in neat rows and columns. you can see them *as* rows, *as* columns, or *as* arranged diagonally,

these appearances being quite different, though the physical object remains unchanged. Here the pattern is obviously due to the intervention of a subjective factor. It is similar with hearing a succession of uniform sounds, we feel impelled to group them, stressing mentally one member of each group to produce a rhythm.

In many cases the physical nature of the object contributes to the integration. The actual relations of the parts have their effect, or the movement of an object isolates it from its context and calls attention to itself as a unity. But the instances in which pattern is applied to material such that the most which can be claimed for it is that it is equally consistent with this, that, or the other pattern, warn us to expect the intervention of a subjective factor in all perception. It would appear that the observer fronts the world armed with a number of ready-made schemes of organization, which he imposes upon the material presented by his sense organs. He normally starts with the perception of an object as a whole, and then by analysis discovers those more elementary experiences which are called in our text-books 'sensations'. But how far the patterns are the result of previous experience is a question to be postponed a while. It is the existence of the subjective integration that is here important, rather than its origin.

We have already noted that the same principles hold good of hearing. The notes of a song reach us one by one, but we hear them as a melody and not as a bare succession. In this case we can point to many physical characteristics of the train of sounds which facilitate the apprehension of the air, and it is not

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suggested that the hearer in any sense invents the melodies. But allowing for the intervals produced by the performer, his accentuation of certain notes to secure rhythm, and the orderly arrangement of the material, we have still to recognize that the mind of the hearer is co-operating. For he can recognize the tune when played on various instruments, in any key, and hear it in spite of the performer's mistakes. He can hear it persisting through many elaborate variations. But others can appreciate only very simple melodies, or perhaps none, and the civilized ear finds difficulty with the music of primitive peoples, failing to detect their complicated rhythms. We have already seen that we can mentally impose rhythm where it is lacking. In listening to speech we grasp the meaning of a whole sentence, and we can repeat from memory a long sentence while we fail to recall an equal number of unrelated words. Integration into a coherent whole is again the outstanding feature.

Let us now return to visual experience to consider the perception that an object is moving. This is surely simple enough. The object *is* moving, and its image traverses the retina. True, but there is no physical motion on the cinema screen, and yet we see figures moving across it. A succession of stationary pictures is projected upon the screen, separated each from each by an interval of darkness.<sup>1</sup> The spectator sees one object in continuous motion from here to there. Is this due to the fact that the sensation produced by light persists for a short time after the

<sup>1</sup> Actually each picture is repeated several times, that is, its total exposure is 'cut'. This is done to avoid flicker and to reduce the effects of persistency of vision.

withdrawal of the stimulus? No, for if the persistence were at all pronounced the result would be an indeterminate blur. In fact, precautions are taken to cut down the after-effects of the stimulation. We can hardly avoid the conclusion that the observer has himself produced motion from a series of static stimuli. The same phenomenon can be studied in a simpler form in those illuminated advertisements in which lamps are arranged in groups of about four, and each of the group is dimmed in turn. Then we perceive a revolving circle of light. Once more an integration of sensory impressions has occurred and a new quality has emerged in consequence. Even when there is real motion the manner of its perception is not without problems. The retina of the eye is a mosaic of minute organs, the rods and cones. Suppose that the image of a moving body travels across a series of cones. Having regard to their size and structure, it is difficult to believe that a single cone can appreciate movement at all. If not, the eye can only register a succession of motionless points, and no matter how closely they may lie together there is no real motion to be found in the eye itself. Yet we 'see' motion.

In whatever manner the perception of motion originates, it presents some very odd features. Most people are aware that if after gazing intently at a red figure they turn the glance to a colourless surface, they will continue to see the figure, but its colour will now be green. This is the so-called negative after-image. If the after-image is projected upon a green surface it stands out as more intensely green than its surroundings. The after-image (which would have been better called an after-sensation) adds

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itself to the sensation produced by the coloured background. Now, in these respects the quality of 'being in motion' behaves very like the quality of redness. If the eyes have been directed towards a steadily passing band of upright lines, and the motion is then arrested, the lines will be seen to move in the opposite direction. Though moving, they never arrive anywhere—an absurdity that warns us again that the mind is no featureless mirror of the material

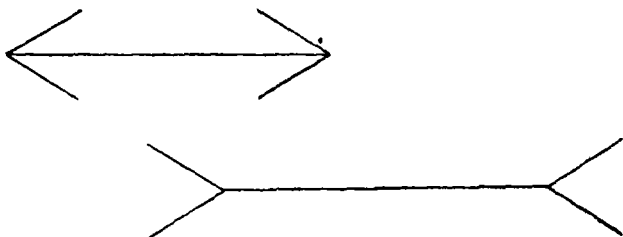


FIG 2

world. Or if the eyes are turned from the first object to another moving with equal speed in the contrary direction, the latter is perceived as moving with more than its true speed (but not reaching its destination any earlier). In short, there is a negative after-image of motion. The phenomena described cannot be related to the material world, and our attempt to state them in terms drawn therefrom has led us to self-contradictory assertions. For in what we call the *real* world that which moves arrives somewhere, and this is not always true in the world as perceived.

Examine next the figures above, and apply the principles we have studied

Each of the two diagrams in turn becomes figure in our first sense, and each is also a configuration of a quite definite kind, that is, it is a figure in the ordinary sense. All our previous statements can be tested again and found to hold true. Thus, by holding the page at a suitable distance from the eye both figures can be seen together and seen clearly, although the number of lines is too great for discrimination. But this is familiar, and there is a new point which requires examination. When the two horizontal lines are measured they are found to be of equal length, although they look so very 'unequal'. How can the mistake arise? It is not a mistake that depends upon knowledge or lack of it, as when we suppose that seven added to four amounts to twelve, for the unequal appearance persists even when we *know* that the lines are equal. We may learn to judge correctly, so that from a number of pairs of figures we can recognize with reasonable certainty the pair with equal lines. But this must be done by consciously allowing for the misleading appearance.

Many suggestions have been offered in explanation of this illusion (which is known as the Muller-Lyer illusion). The only one that survives the test of experiment is that each figure is a unity in which the parts affect each other in perception. One of the whole figures is longer than the other, and its character dominates the parts so completely that it is impossible mentally to isolate the single component. However earnestly we endeavour to limit attention to the horizontal lines they are infected by our awareness of their neighbours, and the impression of length is unwittingly transferred from the total figure to the line contained in it. If this is true we should be able



conscious processes There is no mere addition of item to item, but always an influence of part on part and development towards an integrated whole

Having studied these principles in simple illustrations we may begin to generalize There is every reason to suppose that the laws which hold at this level hold equally of higher mental processes. But we must expect greater complexity there When we discussed reading we found an organization of lines into letters, of letters into words, of words into phrases, the final reading of a sentence implying all the lower levels of integration The structure of the whole is a hierarchy In an army division each grade of the administration has specific functions of its own, but the activities of the higher grades are impossible unless the lower complete their tasks, and those of the lower are worthless until utilized by the higher Similarly the whole animal body has to reconcile the subordination of part to part against the fact that the lowest level is as essential as the highest The process of observation is analogous A picture is a unity, but it has parts which in their turn can be seen as unities embracing a rich variety of details We cannot see the object as a picture until all the grades of integration have been achieved We have seen that the capacity to organize is not equally developed in all persons, and it grows steadily during the earlier years of life A young child when asked to describe a picture enumerates the details, but gives no evidence that he appreciates the picture as a whole. The writer once saw a series of school reading-books containing some elaborate but very attractive black and white illustrations He was surprised to notice that the children took no interest in them, and on

examination he discovered that the pictures to the children's eyes were such incoherent tangles of lines that they could not tell where one depicted object finished and the next began. Yet they were perfectly clear to the adult. So a symphony is a most elaborate hierarchy of organizations which does not reveal itself to the hearer immediately. Each of us has his own limit of apprehension. When the composition makes demands exceeding them we hear sounds in succession, but not music. We must conclude, therefore, that the patterns which we impose upon sensory material are partly dependent upon previous experience and practice.

To summarize our results. Perception normally presents integrated wholes, which are selected from a wide field of possible perception. The wholes perceived display structure, and we have seen that in some cases the structure or configuration is supplied by the mind, and this led us to admit the possibility that in all cases the mind contributes something to the form of what it perceives. At least we must argue from the case of ambiguous figures that it is not only the physical character of the object which determines the pattern. That we should observe unitary configurations is biologically advantageous, since we could not successfully meet the problems presented by the material environment if we had to envisage a world of unrelated items. It would be inconvenient to have to construct the tiger from its stripes before taking the appropriate steps. Organization of experience gives mastery, and so we find that the mind continually tends to find patterns, and to select the simplest and most stable of those which are, from the geometrical standpoint, equally possible. And when

thus integrated, the constituent details are liable to affect each other's character in such a way that the whole cannot be equated with the sum of its parts. It has qualities which only belong to it in virtue of its being a single whole. Since this is found to be true in a striking manner in some examples we must admit the possibility that confluence occurs in all cases, though perhaps only to a minimal degree.

At the present time there is warm controversy as to the manner in which the complex unity perceived is formed, and regarding the relation of the parts to the whole. Two schools, apparently sharply opposed, share the stage. Those who follow Professor Spearman hold that in a typical case we first apprehend the parts and then apprehend relations between them. The structured whole comes into mental being through the relations. 'The mentally presenting of any two or more characters (simple or complex) tends to evoke immediately a knowing of relation between them.'<sup>1</sup> A and B when thus related can form a complex but unitary character or 'fundament' for a further act of cognition, so that in the end a very complex whole can be perceived as a unity by reason of a system of relations of different levels having been educed. To the objection that in many instances it is clear that this piecemeal process does not occur, Professor Spearman legitimately replies that every perception of the adult is affected by his previous experience. Short cuts have been developed, so that we now see the whole structure immediately, though

<sup>1</sup> Spearman *The Nature of Intelligence and the Principles of Cognition* (1923), p. 63. The same author's *Creative Mind* contains a simpler statement of his theories.

only because we had previously cognized the relations between the fundamentals. Moreover, he is prepared to admit degrees of explicitness in the apprehension of relations. We may see *that* two dots are related as being side by side and left and right of each other, or we may see them *as* so related, without explicitly cognizing the relation. But even when these modifications are admitted there remain difficulties in the way of accepting the theory as a sufficient explanation of the integral unity of perceived wholes. In the first place it seems to clash with the intimately felt unity of a simple melody. It is true that a melody can be described in terms of the relations between the notes, but it must be borne in mind that not only relations between successive notes are involved, but the whole range that analysis can discover. A is related to B, and B to C, but A-as-related-to-B must be related to C, and so on. Now, is it possible that the quite untutored hearer must grasp all this wealth of relations before he can enjoy the first hearing of a popular tune? It is true that the better trained musician seeks to enrich his enjoyment of a composition by searching for relations, just as it is true that we can discover relations in a single musical phrase. But something is heard as a unity before that process takes place, and when the analysis is completed the piece of music, whether simple or elaborate, becomes a new and different experience. And even then it seems to the writer questionable whether one can say that the composition is adequately described in terms of notes (fundamentals) and their relations. We may point once more to the Muller-Lyer illusion, and ask how the eduction of relations can account for the difference in seen length.

It is also difficult to understand what the fundamentals are. Any related system of fundamentals can itself become a fundamental, and relations can be fundamentals. Conversely, what is at one stage a simple fundamental may later prove to be complex, for the process of educing relations can work in both directions, analytically as well as synthetically. But what are the simplest, or original fundamentals, and why should a composite fundamental ever be taken as original? To repeat our earlier example, do we see the tiger stripe by stripe, or see the tiger immediately? The former appears impossible, and the latter alternative raises the question as to why I see the tiger rather than the stripes. Which is most truly a fundamental? But it should be noted that Professor Spearman's theory covers a much wider range than our present topic, and that, in consequence, any criticism of this particular section is likely to be unjust.

The rival theory has lately received such substantial extension that it is difficult to state simply so much of it as touches upon the subject of this book.<sup>1</sup> Its cardinal point is that in sensory perception the whole of the figure is seen immediately, that is, without the mediation of any processes of apprehending the parts and relating them. In fact the parts are revealed later. They only exist (mentally) in, and as subordinate to, the whole, the whole is primary. At first sight it may appear that we must find the same difficulty here as we encountered in the case of the fundamentals. What determines whether ABC, AB, or A shall be the whole here and now perceived? The 'Gestalt'

<sup>1</sup> For brilliant and authoritative statements of the theory the reader is referred to Kohler, *Gestalt Psychology* (1930) and Wheeler, *The Laws of Human Nature* (1931). The term *Gestalt* may be taken as equivalent to 'structured whole'.

school of psychology replies that the ultimate unity is the whole field of fact, including both the material world and the percipient organism. This field is a dynamic system of forces, and is in process of differentiation. To see a picture against the wall implies that a differentiation has occurred in our awareness of the environment, to see a part of it is a further stage in the differentiation, which is subject to law. The final consequence of the doctrine is to remove the distinction between physical laws and psychological laws. This extension obviously takes us too far afield to be germane to our present limited discussions, and we must be content to make the following observations. The Gestalt theory does full justice to the integrative aspect of perception, and accounts reasonably well for the phenomena of illusions, as for the perception of real and simulated motion. But it underestimates the importance of analysis and of that apprehension of relations which clears up the confusion in a presented field. In the end the two theories may be regarded as complementary rather than rivals. Our experience of a complex object is never static. The object is always seen as a whole, but one which is developing in clearness and systematic structure, and the conscious apprehension of relations is an essential part of this process. Further, the 'Gestalt' theory gives too little weight to the considerations to be discussed in the next chapter.

### III

#### THE INFLUENCE OF EXPERIENCE

UP to this point we have discussed our problem in a somewhat abstract manner. We have dealt chiefly with artificial instances, and we have almost ignored two very important aspects of perception which must now receive consideration. The observer has a past which largely determines his present character, and, therefore, his perceptions, and those perceptions are concerned with useful or inconvenient material things, such as cabbages and sealing-wax. To the eye there is revealed an expanse of redness, to touch hardness, while our muscles record weight. Does this list exhaust the perception of sealing-wax so that the experience is *completely* described when we have enumerated all those qualities? The answer has already been given, the illusory stick over which I stepped furnishing the data. For it was evident that my eyes correctly reported shape and colour, and that in no case could they give me more than this. The stick which I observed must have been set there by myself, and if this is true in one case it may be true in all. But, it will be said, I can handle the sealing-wax as I could not handle the stick, and in this way complete the one perception as I could not complete the other. That is true enough, but insufficient as an explanation, for in most cases I do not trouble myself to handle the things which I see. The sealing-wax is identified as such at once, by its visible appearance alone. So, comparing the true

with the false perception, we cannot avoid the conclusion that the observer contributes material as well as pattern to his own experience, and we have to investigate its nature.

All perceived objects are meaningful. They are cognized as having significance for our behaviour. The patch of light 'meant' that I must avoid a stumble by stepping over it. But one does not stumble over light, that mishap requires a solid body. In no case, however, could I see solidity (in the sense of hardness—geometrical solidity is another matter), but in the past I have found hardness associated with colour. Colour itself is usually irrelevant to my behaviour, but it serves as a useful warning signal, and so I learn to behave to the colour as I should properly behave to the hardness. In this case the quality of hardness happened to be missing. We have already commented upon the immediacy of my reaction to the stimulus. There was nothing in the way of internal argument that it *must* be a stick which looked thus. The mere appearance triggered off the mental and muscular response, and it would have been just the same with a real stick in any circumstances. We avoid objects in our room or approach them to utilize them, relying entirely upon their visible qualities, which in themselves are neither useful nor harmful. The so-called 'distance' senses (vision, hearing, and smell) are only symbolical. Their function is to warn us in good time of the proximity of material things which possess important qualities that can only be perceived by the more intimate senses of touch, taste, and movement (*kinaesthesia*), but which those senses may reveal too late for our good.

That vision or hearing should serve to initiate



activities appropriate to qualities only perceptible to other senses 'seems simple enough. One school of psychology has studied this process in animals by experimental methods. To take the classic case, a dog's mouth normally secretes saliva when food is placed before the animal. If on many occasions the food is placed before a coloured screen, saliva will in future be secreted in the absence of food when a screen of that colour is shown to the animal. This reaction is called a *conditioned* reflex, and from such experiments (among the most brilliant in science) the theory has been developed that all perception through the symbolic senses can be reduced to conditioning. It is asserted that the meaning of the visual stimulus is to be found in the behaviour which follows it, and that no further psychological problem exists. This theory, known as 'Behaviourism', is very plausible. It would obviously account for many and perhaps all actions, *as seen by an observer other than the agent himself*. The Behaviourist holds that this is the only form of observation which science can admit, so that any talk of consciousness is irrelevant and, indeed, meaningless. We must observe the behaviour of human beings exactly as we study the run of billiard balls. But most people will remain unconvinced by Behaviourist arguments that while the emission of groans provides scientific data, their experience of toothache does not matter. Their friends will be equally reluctant to admit that the boredom, which they think they feel when the sufferings are described in detail, is really reducible without remainder to activities in the muscles of the face. We are all obstinately interested in ourselves, and are consequently disposed to demand that some science should

deal with that personally-felt aspect of experience which Behaviourism ignores. So we hold that, while the sight of sealing-wax may lead to incipient movements directed to the sealing of non-existent letters, yet there is something more, a *consciousness* of the sealing-wax and its uses. And if I may argue to the past from present experiences, there is no doubt that I was conscious of a stick, as I am now conscious of a pen when my eyes reveal a certain blackness. All of that awareness of the pen as more than a black figure must be the product of my own mind. Let us remark once more that I do not *argue* that this blackness indicates the presence of an object with which I may write. I see it immediately *as* a pen. The results of previous experience supplement the sensory data, but not by way of external addition, as when a label is tied to a parcel. Past and present are now linked to form one whole, so indissolubly one that it comes as a shock to realize how little of what we 'see' or 'hear' is actually given by our senses. Our ears cannot even hear words, they give us sound only.

The reader is invited to look around him and reflect on his perception of common objects. I 'see' a clock and 'hear' its tick and the two impressions are in some way unified. But I *perceive* much more than this. The clock tells me the time, and a great deal of experience went to the development of that function. I see it as if there were works inside it, though in fact they are invisible. The cracked vase is placed with the injured side to the wall, but though it will deceive the visitor it can never again look the same to its owner. It is unnecessary to give more illustrations of this point. The 'cold look' of snow is sufficient to warn us that the

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information offered by any one sense is immediately supplemented by experiences gained through others

We thus reach the following conclusions Not only may different modes of sensations be combined in the perception of a single thing, as when we handle the stick of sealing-wax, but in all cases the sensations actually received will be supplemented by suggestions of others which have been linked with them in the past, and there will be a consciousness of significance for action We would stress again that this last factor is not a piece of explicit knowledge The object *looks* apt for a purpose, and it is a unitary experience which we enjoy We can now examine more important cases

Looking around me I perceive a number of solid, that is to say—tridimensional, objects scattered in a tridimensional space I see them as at varying distances from me, this nearer than that and requiring less effort to reach it We take all this for granted Yet the retina can only receive an image in two dimensions The most elaborate system of vertical planes must collapse in the eye as surely as when it is depicted on paper It can be shown that in part the solid or stereoscopic appearance depends upon two eyes being active They being differently situated, each eye receives a picture of the field of view slightly different from that of its fellow The combination of the two gives rise to the appearance of depth, as lustre resulted from the combination of two matt surfaces of different brightness But it is difficult to realize that when one eye is closed much of the scene's solidity disappears A few experiments in attempting to touch points at varying distances when one eye is closed will show convincingly that the perception of spatial relations has been gravely

impaired The reason why we do not ordinarily observe the difference is that we *know* the objects are solid, and this knowledge obscures the evidence of the senses

The binocular contribution to the knowledge of the third dimension fails if the objects regarded are at a considerable distance from the observer Then we have to rely upon other criteria, such as the apparent magnitude of objects, the slope of lines, and the vanishing of parallel lines, in short upon all that is covered by the term 'perspective'. But these in themselves cannot directly show distance They can be reproduced on paper and the eye will then record the same pattern of lines and angles, although now it views only a flat surface It would appear to be the subject's experience of motion amongst objects and over surfaces which has given meaning to the pattern Any one who has tried to estimate distances in an unfamiliar type of country will readily appreciate this point But perhaps the most telling illustration of the mind's intervention is a negative one With pencil held at arm's length measure the apparent size of a person's head, as he stands on the farther side of the room Advance half-way towards him, and the pencil shows that his head has doubled its seen dimensions Reflection will show that the eye must now receive an image of twice the previous linear dimensions But you will never *see* the head grow in size to that extent Knowledge that the real size is constant obscures the sensory impression Consequently children of eleven or twelve find a great difficulty in representing perspective accurately, tending to draw objects in their true proportions instead of as they are seen Yet I have known children of six or less deal creditably with problems of foreshortening

Their vision had not been so much corrupted by their knowledge. So, too, some of us can remember being puzzled by the disparity in size between people across the road and those by our side. In adult life we take but little note of these differences, for we look rather upon the world we have seen than the one actually before us.

When asked the colour of grass we answer at once, 'Green'. The artist knows that as the light falling upon it varies it will pass through the whole range of colour between blue and yellow. It is not merely that we believe it to be green: to our prejudiced eyes it looks green. Walk around the garden as the light fails. You will seem to see the colours of the flowers as long as you can discern the blossoms. Yet the colours disappeared as the dusk fell, and you may be ascribing to particular flowers hues that have never been theirs. Much of the colour which we believe we see belongs to the class of 'memory colours', which usurp the functions of the sense organs. A circle drawn on a card appears as an ellipse when the card is tilted, and the proportions of the ellipse can be calculated if the position of the observer is known. But that observer, asked to select a true ellipse to match the apparent one, always selects one too round. Involuntarily and unwittingly he has partially allowed for the perspective. The known roundness infects his judgment of the visible shape.

When some part of our previous knowledge has recently been stimulated into activity our perception of related objects is liable to be more than usually fallacious. It is notorious that when eagerly awaiting a friend we are prone to identify as him strangers who do not closely resemble him. The conjurer knows of this, and by his patter builds up a misdirected

expectation To put the case more generally, if our attention is already directed to a coming event and guided by an idea of what is likely to be seen, we shall apprehend it more readily and certainly if it occurs, but equally we shall apprehend the actual event imperfectly if it is other than expected We facilitate our perception at the cost of becoming a ready prey to the illusionist <sup>1</sup> If two events, appealing to different senses, such as a flash of light and the sound of a gong, occur simultaneously, the one to which attention has been predicted appears to occur first If they occur in close succession the second may seem to be the earlier, if it has been favoured by expectation This phenomenon, called (none too aptly) pre-perception, is well known We direct our companion's attention to what we wish him to see and tell him what to look out for It is advantageous for him to do this, but there are risks of mistake introduced

We shall be prepared to find these principles evincing themselves on a more considerable scale when emotion or strong desire govern the observer. If the wish is father to the thought it has another progeny in false perceptions, anomalous selections, and in interpretations more consistent with emotion and desire than with the actual situation Here, too, experimental methods can be applied We have already seen that some objective groupings are capable of accepting more than one mental configuration. The well-known figure that can be seen as a flight of steps viewed either from above or below is a good instance The two appearances normally fluctuate

<sup>1</sup> I was told by an expert amateur conjurer that while it was far more difficult to deceive children than adults, he had found it impossible to deceive dogs

with fair regularity, but it is found possible by determined effort to maintain one phase in consciousness for longer periods than normal. Purposing to see that aspect, we see it in preference to its rival. The purpose has affected the perceptual experience by selecting and intensifying one configuration. But we usually observe with a purpose in view, and consequently we must conclude that in all cases our purpose affects our apprehension of the outer world. Purpose governs the initial selection within the total presented field and the further selection of the configuration, and also the emphasis of particular details. The interpretation given to the facts is equally dependent upon purpose. We see what we want to see. This is an ambiguous statement, but both of its possible meanings are true, for not only are we most conscious of what is relevant to our purpose (the observation is directed) but also we may see what is convenient when the facts are in truth otherwise. It is selective purpose that we have in mind when we speak of 'interest', and at a later stage we shall consider the permanent interests of the observer as determinants of his capacity to observe.

When purpose is intensified by emotion its selective power is increased. It is a characteristic of emotion that it inhibits ordinary associations. The angry man fails to remember those countervailing arguments against his embittered judgment of an adversary which would have immediately occurred to him in a cool moment. Similarly, the perceptual data receive an interpretation so narrowly selected that we must call it distorted.<sup>1</sup> To consider the parallel case of the excited listener who wrests sentences from

<sup>1</sup> Although the argument has not yet afforded any foundation for the distinction of true and false

their context by selective emphasis and gives them an unintended meaning would take us beyond the limits of this book, but we must observe how, under emotion, facial expression, and vocal intonation are interpreted and often misrepresented. This may occur even in comparatively calm moments. On one occasion (mentioned in the beginning of the next chapter) the writer was described by some observers as displaying indignant surprise, while to others he evinced the calm interest of one 'obviously expecting the incident'. But, as the reader will now readily admit, faces cannot really 'look' contemptuous, or voices, 'sound' angry. They can only present certain sensory qualities and patterns which we have learned to associate with mental attitudes. Then we unconsciously select the details which are consistent with our mental state, and so construct evidence for ascribing to another those feelings which we should like him to exhibit at that moment.

We have an equal aptitude for shutting out what we do not wish to see. This can be demonstrated at an early stage of the complete process. The practised scientist when using a microscope keeps both eyes open, but the one which is gazing at the bench apparently sees nothing, although it must receive an image and transmit nervous impulses to the brain as perfectly as the other. In some inexplicable manner the unwanted field is suppressed. A surprisingly large number of people exhibit this phenomena of sensory suppression in everyday life. If one eye is inferior in definition to the other its use is inhibited, and the person goes about the world unaware that he is functionally blind in one eye.<sup>1</sup> Once more we are led to expect

<sup>1</sup> Functionally, not organically. The suppressed eye can see when the good one is closed. Some employ one eye for distant vision and the other when viewing near objects.



interpretation vary widely from one to another. And the capacity to integrate is not given to all persons in the same degree. We have seen reason to regard it as an essential factor in intelligence. We can trace its growth in children, and remembering how slight their experience of the material world is, and how imperfectly developed their powers of organization, it is clear that they must live in a world very different from ours. We are too ready to assume that we have but to put objects before them for perfect apprehension to occur. In fact they may only perceive a confused jumble of light and shade, and in no case can they perceive the same object as ourselves. A savage cannot perceive a typewriter. He will see only a material thing, ignoring the details and reading into it no purposive implications. If he is sufficiently intelligent he may be taught at long last to use it, and then he will perceive it very much as we do. Similarly the child has to learn his world actively and in use.

We must therefore consider how our analysis bears upon the problem of the general validity of our sense experience. Can we still believe that our senses are capable of yielding accurate knowledge of the material world? It would appear that man, in constructing his universe, often blunders in the process. But it must be observed that we have been compelled to devote a disproportionate amount of attention to error and illusion. They are our test cases. In an intact organism it is next to impossible to discover the functions of particular organs and their contribution to the well-being of the whole, so the physiologist has recourse to experiments, in which he changes or removes now this organ, now that. Our experiments with illusions are like his. They are a kind of mental

vivisection By studying instances in which perception is grossly at fault we can judge how correct perception is brought about, and this is our proper aim Too great scepticism is readily defeated by the considerations that we live successfully by means of our sense organs, and that we could not have dealt at all with error save by assuming the existence of truth.

Yet there is an important problem here, and we can find no ready solution of it To take the case of vision, we have to confess that what we see, we see, and that we can get no direct acquaintance of an object except *as* we see it Hence it appears impossible to say that one perception is true and another false In themselves they are both facts and as such stand on a level But let us remember that perception is subordinate to action The primary aim is not to acquire knowledge as such, but to obtain guidance for movement This at once produces a distinction From this point of view some perceptions are useful and others not To the vision of one eye a painted apple may look the same as a real one At least there is nothing which so distinguishes them that we can say at once that this is real and that false The only test is to try to lift them We call that appearance true which is linked with the experiences which we expect to arise from that action So, generally, the true perception is the one upon which we can act successfully This common-sense attitude marks the further point that we identify the real by experiences derived from handling

One illusion has been popular with philosophers A perfectly straight stick when half immersed in water appears to be bent at the point at which it emerges

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from water into air Which is true, then, the straightness in air or the bentness when half in water ? The test is to aim at a mark under water, or to run the hand along the stick We then say that it is *really* straight but *looks* bent But the judgment takes this form because we are accustomed to handling sticks in air If in nearly all cases we had seen and used long objects half immersed we should regard their visible appearance as the normal sign of straightness, and reverse the use of the epithets Here we have a clue to the solution of the problem We check the appearance in one sensory department by those in others That appearance which holds together consistently with others, and is available as a guide for behaviour, is true With the increase of knowledge other factors enter in, as when by studying the laws of refraction we learn that a stick *must* look bent under those conditions Then we cease to regard it as illusory So it comes about in many cases that we recognize the false to be such immediately, other relevant experiences supplementing the sensory data and providing a corrected perception We say that we meet the same object in a variety of contexts The actual sensory experience is that of recognizing a group of impressions which form a figure against varying backgrounds This accentuates the unity of the figure and again increases the facility of recognition, but at the cost of obscuring the minor differences which are sure to be present For most immediate purposes, for initiating a course of action, for taking up a defensive posture, the barest recognition is usually sufficient, and the variations in form due to differences of position are ignored because they have no practical value. So we build up a collection of

standard perceptions which suffice to guide our actions, and these serve as criteria of the truth of sense knowledge. Any appearance which disturbs the customary mental attitude seems to strike us as wrong, even though it may be physically inevitable, as in the case of the bent stick.

The elementary facts of perspective furnish examples of this. The top of a round jar is nearly always presented to the eye as an ellipse varying in width with the position of the object. But all the variant shapes are related to the experience of handling the jar and using it, so that we can neglect the peculiarities of the appearance. An expectation of roundness has been established, and, as already mentioned, it excites a tendency to 'see' the ellipse more nearly round than the laws of perspective permit. The matchbox looks small across the room and larger close at hand. Which of all the apparent sizes is the true one? This question sounds foolish as we raise it. The answer seems to be that we take as the standard that visible size which is presented when the box is handled. The real size of a person is as we see him at a convenient distance for conversation.

We must remember, too, that there are more definite ways of checking appearance against fact. We experiment by other forms of perception, which may involve the use of measuring instruments. For the single perception is as little a solitary and detached experience as are the elementary sensations which constitute it. It is intimately woven into the whole texture of our experience. What we know is brought to bear upon what we observe for its interpretation. We know how perspective arises (even though most people have only a confused idea of it), and so we cease to be

puzzled by the apparently changing shape of the table as we walk round it. We are too firmly convinced of the object's permanence to ascribe the change to that

So far, then, we may regard our sensory experience as on the whole trustworthy. But a more fundamental form of the problem remains to be noticed. Seeing that in all cases the structured universe which we perceive is in some measure 'mind dependent', built up as it is by selection, integration, confluence, and supplementation, what justification is there for assuming that we ever obtain a valid picture of that thoroughly real and objective world that we wish to know? Surely the result of psychological analysis cannot be to reduce all the stage and scenery of man's life to a quasi-artistic creation of his own. The issue raised is vital to all knowledge. The most abstract constructions of modern science must rest upon sensory evidence, and if that is discredited they fall too. In occasional details, as we have seen, it is possible to correct a misleading impression by other sensory evidence, but this cannot be done for the structure as a whole.

A doubt which has disturbed thinkers for many centuries cannot be set at rest here, but it may be serviceable to indicate certain possible responses to it. Many will make the reply that since this world of experience is the only one we can know, and it proves adequate for the complex purposes of human life, there is no need to look beyond it. It is as unnecessary as futile to attempt to do so. Even if there were a sudden miracle of intellectual revelation we should still have to live in this partly subjective world. There is force in this contention, but probably no one has ever been satisfied with it. Another reasonable and entirely true reply would be that psychology has never

professed to deal with the question Its sphere is that of observed fact, and when it has analysed its data it has no responsibility for the intellectual consequences of its discoveries It set out to study the appearance of the so-called material world, and it has neither the will nor the method for elucidating the world as it is in itself The problem must be handed over to the philosopher This is a perfectly just statement of the limitations of psychology The philosopher, however, might fairly retort that, while agreeing, and commending his colleague's modesty, he would nevertheless desire some helpful statement on this matter. The physicist claims to depict the world as it is, and the psychologist to unfold how it looks to the human observer. Surely they can give some guidance to the philosopher in his more difficult task of reconciling the two

Thus challenged, we reply in the first place that it is evident that the causes of our experience are independent of us We do not create the sensory material upon which we impose psychological law Then, having granted the existence of a world independent of the individual mind, we can state next that this world is at least not inconsistent with our construction of it It permits us to view it as structured even though we know that in some cases (for example, ambiguous figures) the structure is mainly subjective Also, by collateral evidence and by experiment we learn that there are certain objective characters which facilitate, and others which impede, systematic perception The dots must not be too far apart if we are to integrate them ; the notes must not be too widely separated in time if we are to hear the melody. We can therefore believe that there is that in nature

which co-operates with the human mind. Most important of all, we are able to effect our purposes by means of our perceptions, and this might be taken as evidence that the world of sense and the world which makes sense possible are not too remotely separated. A being with other mental laws than ours would envisage a very different universe, one as unlike ours perhaps as the movement on the screen is unlike the series of motionless and separate pictures in the film. Yet, as they are intelligibly connected, so would be those two differently perceived worlds.

This is as far as the psychologist may go without trespassing in his neighbour's garden. Doubts must remain. We have no right to assume that the higher activities of the mind are discontinuous with those of perception. The same laws may hold, and the world of scientific thought be but a construction of the thinker's own mind. This is not a fantasy of the psychologist. Modern physical science has felt the same misgivings. 'All through the physical world runs that unknown content, which must surely be the stuff of our consciousness. Here is a hint of aspects deep within the world of physics, and yet unattainable by the methods of physics. And, moreover, we have found that where science has progressed the farthest, the mind has but regained from nature that which the mind has put into nature.'

'We have found a strange foot-print on the shores of the unknown. We have devised profound theories, one after another, to account for its origin. At last, we have succeeded in reconstructing the creature that made the foot-print. And lo! it is our own.'<sup>1</sup>

<sup>1</sup> A. S. Eddington. *Space Time and Gravitation*, p. 200 (Cambridge, 1921)

#### IV

#### THE EYE-WITNESS

ONE day while I was lecturing to a large class of undergraduates on the subject of observation, two senior students made a sudden and violent entrance into the room, engaged in unbecoming and noisy behaviour for a few moments, and then quietly left. By a happy coincidence paper had been distributed for some purpose, and I immediately requested all the members of the class to write a detailed account of what had occurred. To avoid the possibility that they had consciously or otherwise selected what seemed most important and omitted other points which they had observed, I asked them when they had finished their original reports to revise them, and to be sure that they had included the answers to some questions which I then put to them, provided of course that they felt sure of the answers. An accurate and full report required just ten essential points. The average number correctly reported was 3.5, and on the average there was one completely false addition. These additions were very various. Incidents which had not occurred, and some which were physically impossible in that room, were reported with complete assurance. Some episodes were seen to occur twice. The noisiest item of all was reported by only one witness out of seventy, and that the one most remote from the action. After calculating the numerical results I handed the reports to several of my colleagues, and invited them to extract from them



a full account of what had occurred. They all found that the records were too widely and wildly inconsistent to permit them to learn more than that some kind of disturbance had taken place. Yet the action had been striking and calculated to draw attention by its sudden occurrence, and the witnesses were intelligent and honest. More recently a short film (lasting approximately three minutes) was displayed to about forty schoolgirls. At the end they were asked, among other questions, whether the lamp had been on the table or hanging from the ceiling. The answers were about equally divided between the two alternatives, but without exception each girl ascribed it to one of the two positions, though in fact there had been neither lamp nor table. When the experiment was repeated with adult subjects they proved less ingenuous. Nevertheless, in each group with whom we tried it some one was found who confidently located the non-existent lamp.

Many similar experiments have been performed, either with enacted scenes or cinematograph material. The results are remarkably consistent. Not only is the report offered disappointingly incomplete, but even of the scanty testimony, offered by the eye-witness in all good faith, some 40 per cent is false. When this has been realized the somewhat abstract themes of the previous chapters suddenly spring to life. For testimony concerns us all. On reading that word the mind naturally turns to the courts, but in a less technical sense we have recourse to testimony in many everyday situations. The petty 'crimes' of the schoolroom, the symptoms foretelling the oncoming of sickness, the absence of an expected friend, or even the question where we left our pocket-book, all these

may turn upon the evidence of an eye-witness. It is well to reflect on this before proceeding to a detailed discussion. Giving and receiving evidence are among the commonest and most important of daily incidents. So it is worth while to examine the lamentable results illustrated in our experiments, because not only is the incompleteness of evidence crippling, but the false testimony may be injurious to some person<sup>1</sup>. At the time of my first experiment a case was reported in the Press in which several people had asserted that they were prepared to identify a stranger, who had casually passed them in a dark street at night. We can judge the likelihood of their evidence being true, and the extent of the mischief it might cause. So we shall try to discover some of the limitations of the validity of first-hand evidence and the reasons why errors occur. Aware of the pitfalls, we may be able to avoid some of them.

We have now to deal with far more complex circumstances than in our former inquiries. The 'configurations' presented are more elaborate and the interpretation more liable to variation. There is usually no opportunity to repeat the observation, which has to be prompt. Another process enters into the problem. The facts have not only to be observed at once, but also to be reported after an interval. We consequently have to take into account the memory of the witness. This was true even in the case of our simple experiments upon perception, but there we

<sup>1</sup> In this discussion the only 'false testimony' considered is that offered in error by honest witnesses. The psychology of the deliberately false witness is a topic we need not discuss here. Further, it is to be assumed that the witness is not personally interested in the results of his evidence, unless the contrary is explicitly stated.

could afford to neglect it, since the report could be given at once and checked by a second observation. We must not neglect it here, since the validity of testimony depends as much upon memory as upon initial observation. In fact, the operations of the two processes cannot be disentangled, and we must be content to accept what the witness remembers (or imagines) that he saw, because generally there is no opportunity to reconstruct the facts to obtain a fresh observation. We cannot here treat of memory fully, but the reader is probably already acquainted with some of its limitations.

First let us notice that all the principles brought out in the earlier chapters hold good in this more concrete and important sphere. There is the inevitable limitation and selection within the presented field, the tendency to integrate (perhaps arbitrarily) the data into a coherent whole, and the consequent masking of detail. Thus all my witnesses saw *a* disturbance, but apparently saw but few of its characters, although this last statement must be taken subject to the possibility of memory distortion. We saw, too, that memory can supplement the simplest data, perhaps falsifying them thereby. So we may discredit the witness who describes the colours of a dress which he saw in a dim light. At the worst the colour may have been a 'memory colour',<sup>1</sup> at the best the description only holds good for those particular circumstances. For the failing light does not affect all colours equally. Green becomes relatively brighter than other colours, deep red becomes black, and your pink roses take on a bluish tinge. That artificial light is liable to distort colour is too well known to need

<sup>1</sup> See p. 36

further statement Yet witnesses ignore their limitations and are prepared to swear to the colours they have seen and to identify them under quite different conditions Very few people are aware that only the central region of each eye can recognize the full range of colour or register a clear image of form. This limitation is overcome by automatically directing the gaze to any object which we wish to observe in detail In very dim light, however, this region of the eye is blind, so that another hindrance to perception is introduced.<sup>1</sup> On the other hand, the margins of the eyes are the quicker to perceive motion, and a moving body seen 'from the corner of the eye' appears to move with more than its true velocity So there is a wider field of vision for the perception of motion than of form, and consequently we usually note the motion and then turn the eye in the proper direction to pick out the form of the moving object This widening of the field of vision for motion is advantageous, because it is the moving body which is important as enemy or prey The eyes of most animals are badly designed for the discrimination of form, but they tend to exaggerate an object's motion, as does the periphery of the human eye But at night when we turn to look directly at the object which has drawn attention to itself by moving, its image may disappear, being so small as to fall entirely within the limits of the now blind fovea

Sound is as treacherous as colour. We can judge excellently the direction from which it comes if the source is to left or right of us, but there is no possibility of judging whether the source is behind us or in front.

<sup>1</sup> This is true of *nearly* all people A few seem to be abnormal in this respect.

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There is a tendency to place it behind, that is, on the zone unguarded by the eyes<sup>1</sup> Ordinarily we identify the direction of a continuous sound by turning the head until the line through the two ears is directed towards the source, although even then neighbouring objects may cause, by reflection of the sound waves, an error analogous to that of the apparently bent stick But it is entirely a matter of chance whether our position is such as to enable us to observe correctly the direction of a single sharp sound Judgments as to the intensity of sound are also very fallacious. Generally the more intense sound masks the feebler, but directed attention may reduce the loud sound to the status of 'ground' on which the weaker stands out as 'figure' We have the happy gift of becoming inured to continuous sounds, so that conversation can be carried on comfortably in a factory Unwanted sounds (that is, those other than the material features or events to which we are attending) may be ignored altogether Having to carry out some experiments which required undisturbed observation and having only inadequate and noisy apparatus available, the writer was afraid that the results would be vitiated by the distraction At the end his subjects were able to reassure him by saying that, while observing, they were never conscious of the sound This convenient oblivion might have caused difficulty in the witness-box We

<sup>1</sup> The reader, testing this on the sounds around him, will find it difficult to believe Yet systematic experimentation is convincing The solution of the apparent contradiction is to be found in Chapter III He has built up systematic knowledge of his familiar surroundings and the sounds which emanate from it, and this knowledge can no longer be divorced from the sounds themselves

become habituated to odours still more readily. A very pungent and offensive smell becomes imperceptible in a short time some localities would be impossible for human habitation otherwise. So in these two fields we must not expect accurate reports, except for experiences which arise suddenly, or to which the observer comes fresh. And, in general, first hand evidence of an event is at its weakest on the negative side, for it is impossible for any one to be certain that he noted everything. Sensory adaptation as well as distraction may cause an important element in an event to be overlooked.

We know that the more definitely the whole structure as such is observed the less likely are details to be discerned, and we shall be properly suspicious of a report which offers a great wealth of them. Yet we must be cautious here. Some persons (more frequently children than adults) possess the power of reviving an extraordinarily vivid visual image of what they observe, so that they can discriminate at leisure the details which there was no time to observe during the experience itself. When shown a complicated design, such as an elaborate poster, for a few seconds, they can describe it in full detail and reproduce the lettering, even when the latter is in a language unknown to them. It is probable that all persons occasionally enjoy imagery of this 'eidetic' type, and circumstances which excite attention without fostering immediate integration are favourable to its occurrence. A witness may thus register an unexpected incident with extreme fidelity, but as there is no ready way of ascertaining whether his memory of it is of this unusual type, his evidence must remain suspect. A person may

experience imagery of this kind fortuitously on just a few occasions, without its being in any way characteristic of his manner of remembering. In all cases more credence should be placed in his account of dress, features, and other permanent aspects, than in his memory of the sequence of events

In many cases the witness is called upon to form a judgment on the basis of his observation. It is not commonly recognized that the 'evidence of the senses' is then only the beginning of a process, which is mainly intellectual. A witness reports that he saw a man standing six feet away from the lamp-post. This conventional manner of speaking disguises the true character of the process. Actually he saw a man and a lamp-post separated from each other, and *judged* the separation of the two to be six feet, the basis of this judgment being very complex. We cannot see space as such. We see objects, and judge space by reference to them. In our example the observer had to judge his own distance from the man and the post before he could estimate the amount of separation. If they had been twice as far apart, but twice as far from him, the eye would have recorded the same extent of separation. This basic judgment depends upon previous experience of similar objects in similar contexts. In the first place, he must know the 'real size' of such objects.<sup>1</sup> Then he has to compare, however unconsciously and implicitly, the visible magnitude with this standard. Such comparisons afford plentiful occasions for error. An object looks large or small according as it is surrounded by small or large objects. There is no accurate impression of absolute size. Gaze

<sup>1</sup> See p 45.

fixedly at a lamp for a few seconds, and then close the eyes. Very soon an 'after image' of the lamp appears. This *must* be actually as large as the image received by the retina while looking at the lamp, but it appears ridiculously small now that it is isolated from its context. Experience is, then, essential, and it must have been gained in similar environments. It has already been remarked that in unfamiliar districts our judgment of distance is very faulty, as when the landsman grossly underestimates distances at sea. Moreover, the object to which we attend is mentally exaggerated, and consequently judged to be either too big or too near. The camera is, of course, immune from this propensity, and thus causes many disappointments for the amateur photographer, who expected *his* vision to be recorded.

Another source of error is provided by the attempt to judge distance in terms of a standard unit, as in the example above. Normally we only judge an object to be very near, or rather far off, and so on, the terms used having but a rough significance. To estimate in terms of precise units requires much experience, and accuracy demands an amount of training which few have enjoyed.



This diagram illustrates the dependence of the estimation of distance upon objects. The distance from  $a$  to  $b$  is equal to that from  $c$  to  $d$ , but appears slightly greater. Generalizing from this we can say that filled spaces are over-estimated in relation to empty ones. The bare room looks too small. But if the objects are unusually crowded together the space



may seem too small for them, and therefore absolutely small, as in the case of the over-furnished room.

Judgments as to the lapse of time between events are extremely unreliable. There is no actual perception of time as such. We are conscious that a sound persists and we can say that it lasted for a long or a short time. Also we can compare two brief intervals, and say with some certainty which ~~was~~ the longer, provided that our experience in each of the periods is the same. Experiment has revealed how sensitive this judgment is to any change in what is experienced during the test periods. In the case of short intervals, that is, of a few seconds (which is as much as many witnesses of accidents are concerned with), it is found that 'filled' time is over-estimated in comparison with empty time. The richer the experience the longer it seems to last. But a pleasant experience passes more rapidly than an unpleasant one. The fundamental difficulty is that every judgment of the lapse of time involves a comparison, but no firm standard is available. If we are working against time we judge by our progress towards our goal, and the time seems very short. For our own thoughts and emotions play as important a part in filling time as the external events which we have to observe, so that the whole process becomes hopelessly subjective. Yet animals seem to have some power to estimate the lapse of time, and perhaps we should do better if watches were not so cheap. As it is, no reliance at all can be placed upon human judgments of time.

We are all acquainted with the discrepant estimates of speed offered by witnesses in the courts. Here, too, we are dealing with judgment upon observed

fact. We see a body in motion. To say that it is moving slowly implies comparison with some standard. To say that it is travelling at ten miles an hour needs very accurate comparison with a precise standard. The former comparison rests upon experience of things and of our own movements. The latter is entirely artificial. Now, velocity can only be defined in terms of space and time (as when we said 'ten miles an hour'), and the judgment of observed motion is psychologically dependent upon observation of those two variables. Consequently our estimate of speed will be infected by the errors we have noted above. By practice a reasonable degree of facility can be acquired in judging the speed of a passing vehicle or of the one in which we travel. But the judgment is always at the mercy of chance and irrelevant circumstances. The size of the car, the noise it makes, other moving objects in the vicinity, all of these go to make up the configuration from which the one factor of speed has to be isolated. The act of attention itself may affect our judgment of time, and in consequence that of speed. This was brought home to me vividly when witnessing a trivial accident. As the car approached the pedestrian it was losing speed, and in fact came to rest as it knocked him over. But as I saw it, it travelled incredibly slowly, as if affording time to its victim to look well about him and make up his mind what to do. The car then seemed to push him quite gently, and the man slowly bent backwards, and slowly fell. At that moment events resumed their normal *tempo*. The episode had much of the fantastic quality of a scene in H. G. Wells' story *The New Accelerator*. A similar slowing down of perceived motion was experienced

in a harmless collision. The vehicles were actually approaching each other slowly, but not with the impossible slowness which they seemed to adopt when I realized that the collision was inevitable. There appeared to be time for the most intricate manœuvres, or to bring the car to rest. And I had not known that an omnibus is such a towering, cliff-like structure, until just before the impact. In both cases the emotionally stressed attention was increasing the 'filling' of the period and so disturbing the sense of time. Time being subjectively extended, speed suffered a corresponding reduction. Many road accidents are due to inability to judge the speed of traffic, and any subjective disturbance increases the peril.

Whatever he has seen or heard, our witness must wait at least a short time before making his report, and during that period changes will take place in what he remembers. We have seen how much can be reported immediately after the event, how much could have been reported a week later? We have all played a game in which a story is whispered to a player, who repeats it to the next, and so on until it returns in mutilated form to the original narrator. A similar game can be played with simple designs or pictures. Show the original to one person sufficiently long to enable him to grasp the details, and invite him to copy it from memory. Then pass on his copy to the next person, and repeat around the group. The tenth copy will be very unlike the original. It will have been simplified enormously by the omission of details, and some slight distortion in one of the earlier reproductions is usually exaggerated bit by bit until an entirely new feature is introduced. How

little our memory can recall even of what has been frequently seen can be illustrated by inviting friends to draw the diamond frame of a bicycle, showing the position of the pedals

We know all too well how rapidly our memories decay To-day I read a passage of descriptive prose, of about the same length as this page, to some highly educated adults, and immediately afterwards invited them to reproduce as much as they could remember, not necessarily in the words which they had heard None gave as much as 50 per cent, and some less than 20 Yet they had heard and understood it all, and, moreover, they were listening with the intent to remember Now it must be noticed that reproducing in this way, or giving evidence in the witness-box, is a very artificial activity Our powers of remembering have not developed to the end that we may live again through the past, but to assist our present purposes by enabling us to profit by past experience Rapid oblivescence is in part convenient, in part a handicap We have found the means to reduce the handicap in intelligent reconstruction. When we fail to remember that an event occurred, we argue from more certain premises that it must have occurred, and thus we fill in the gaps. Often the process is quite explicit, but it may take place without our knowing of it Actually much of what we think that we remember is a blend of true memory, imagination, and thought No doubt the composite is in most cases true enough, but there can be no guarantee that it is One of the writer's follies was to take a long walk to photograph a charming doorway in an old house that he had often seen. But the doorway could not be found, and he discovered later

that he had added a quite suitable (but entirely unconnected) door of which he had seen a picture. The 'memory' was as clear and as confidently held as could be desired, and but for the test he would have remained convinced that he had seen it in a particular spot. This is a gross case of supplementation, sufficient to inform us that much that we 'remember' is an involuntary creation. Notice, too, that confidence that our memory is correct affords no indication whatever of its reliability.

There is the further risk that reorganization of material may have taken place during the interval between experience and report. We 'tidy up' our recollections and form them into a coherent narrative (another instance of the integration which is now familiar). So, when omissions and supplementation have played their part, a further falsification may have occurred through a change in the emphasis on constituent details, and in their balance. An attempt to make our report clear or convincing to a hearer will cause us to stress this feature or that, thereby initiating further changes in the substance of the memory. To be questioned may start off fresh processes of association, and introduce new and false material into our story. It is unlikely that any of my subjects would have introduced a lamp into the scene but for the suggestion contained in my question. The word called up a picture, which gradually developed to clearness, and clearness gave conviction. Questioning is likely to suggest a suitable fact,<sup>1</sup>

<sup>1</sup> The suggested supplement must be consistent with the original, or it will be rejected. There might have been a lamp in the medieval scene exhibited, and the suggestion of the question provided one, whereas the question, 'Where was the sewing-machine?' would have been received with derision.

which connects itself with the system of ideas awakened, and having once joined them is remembered with them, because the original impression is subtly contaminated by each effort to recall. Memory excited for the second time is partly a memory of the original experience, and partly a memory of the first attempt to remember. Often we are unable to distinguish the one from the other. Then the first mistake becomes permanent. It is not only in cross-examination that this occurs, for every kind of intercourse has its suggestive influence.

We have still to consider the special personal factors which affect an observer's ability to testify as to what took place 'before his eyes'. Take the case of a street incident. The future witness is walking along, possibly thinking of nothing at all, perhaps deeply immersed in thought of business transactions, and in either case barely conscious of his surroundings. His attention is either quite desultory and undirected, or definitely directed to his own ideas, but in neither case is it pre-directed to the events about to happen. To this new field he has now to turn his attention, and this cannot take place so rapidly as we are accustomed to suppose, for under the most favourable conditions it requires nearly two seconds for attention to become fully effective. If his mind was active in another direction there will also be at first a disabling sense of disturbance and flurry. So much may have happened before he became fully aware of the incident, and because he missed the beginning of the sequence of events, what he first notices will be irrational and chaotic. Here is a promising field for supplementation and integration. To the inevitable flurry that

occurs momentarily whenever the direction of our mental activity is abruptly changed may be added that caused by the emotion excited by the scene. And emotion is a great disturber of evidence. It confuses both the original observation and the memory of it. Certain details impress themselves vividly, while others, and the relations between them, are obscured. Memory will start with these characters, accentuate them, and thus a false colouring is given to the whole. Under very intense emotion memory may fail us altogether. The presence of a crowd often increases the bystander's disturbance. Emotion is heightened by being shared, excitement with its attendant confusion is intensified, and chance words give an impetus to imagination. 'Did you see him skid?' says one, in a tone of perfect conviction, and others, who did not, promptly picture it, and at a later date cannot be convinced that they did not see it. In some cases a collective hallucination is built up piecemeal in this way.

Lastly, we have to allow for the bias introduced by the personal interests of the witness. We need not here discuss cases in which evidence is deliberately falsified, personal bias can stop short of perjury, and still be significant. Each of us tends to mould the world to his liking, both in observation and in memory. Pride is sufficient to lead to a misinterpretation of another's gestures or tone. The desire to cut a good figure or to advance our material interests may lead us to the involuntary selection of material conducive to those ends, a selection of which we should be thoroughly ashamed if we are aware of it. 'The truth, the whole truth, and nothing but the truth', can be assembled for narration in such

a way as to create a quite misleading impression, and this may come about innocently enough. For there is the verbal paradox that intense personal interest and its resulting bias may be highly 'disinterested' in the popular sense of the term, as when our sympathy for the victim of an accident leads us to over-estimate the seeming carelessness of the other party, to the point of culpability. The psychological processes work as surely in such circumstances as if we were moved by personal enmity.

What practical conclusions can be drawn from these considerations? However untrustworthy the most honest first-hand evidence may be, we are nevertheless compelled to utilize it, as much in private life as in the law courts. But aware now of the dangers, though we cannot prevent inaccuracy in evidence we may see how to reduce it, and take steps to render it more innocuous.

We cannot train witnesses in advance. The possible fields are too numerous to allow preparation, and, moreover, we all hope to avoid having to give evidence on an important occasion. Nor can we recommend any line of immediate preparation for observing particular incidents, for these always take us by surprise. There is little we can offer by way of instruction, other than such rough-and-ready precautions as may have been suggested by the preceding discussion. If the onlooker is cool enough to remember that he may be called upon to testify, he will, if wise, seek to concentrate his attention upon details, since details are commonly omitted or falsified by witnesses. It is better to be certain of the number of the car than of the distance through which the cyclist was thrown. The drama can generally be reconstructed sufficiently



well from fragmentary reports and circumstantial evidence if the actors can be identified. So the future witness can do good service by turning from the more impressive features of the episode, and from the incident as a whole, in order to record mentally just a few points, without pausing to judge too closely which are the most useful. *Purposing to remember* is an all-important factor in both observation and recall. Then a more or less passive 'living through again' of the experience immediately afterwards does much to clear up confusion about subordinate aspects and to fix them in memory. But it may be said, and justly, that we are demanding a degree of cold-blooded detachment which not all can achieve under the stress of sudden excitement, and that bystanders might perhaps be better employed in rendering assistance than in preparing their evidence. There we must leave it.

It is still more impossible to give advice as to the kind of observation that would enable us to give useful information on matters of everyday concern. Unless we can foresee what we may be asked about there is no direction for attention. We cannot observe everything.<sup>1</sup>

When the ordeal comes, whether in home or in court, the best plan is to avoid any great effort to remember, as that encourages supplementation. Offer what comes naturally and clearly, and stifle any false pride that stands in the way of confessing ignorance.

It is easier to offer advice to those who have to receive and act upon first-hand evidence, but they will not find it easy to put it into practice. In the first place, the character of the witness has to be

<sup>1</sup> This will receive further discussion in the next chapter.

evaluated As a matter of course we reject the deliberate liar (if we can detect him) and the disordered mind, but we then have to inquire whether this conscientious witness, who is now so calm, was at the moment so overwhelmed by emotion as to be unable to apprehend and memorize the necessary range of facts Or is he imaginative, or easily swayed by suggestion? Having these points in mind, you will next see to it that your questions are neutral in character, and especially, if you hope to hear the truth, you will avoid indicating what you would like the answer to be To reveal that would almost certainly create bias, its direction depending upon the relation of the witness to the examiner. And when all these precautions have been taken, we have still to face the ominous facts revealed by experiment But in one respect the results of these experiments go too far To obtain results in tabulated form it is necessary to regard each item in the acted scene as a unit of equal importance with each of the others, and this is not entirely sound The witnesses may reasonably protest that they have reported what matters most, and that they have correctly related the essential outline of what they saw. But while this has its force, it must be remembered that it is impossible to determine in advance what is of major importance, and even on reflection we cannot accurately value one item against another Therefore the experiments still tend to discredit the eye-witness, though we can regard him rather more hopefully than they suggest.

We know in broad outline how much a witness can be expected to recall, the spheres in which observation (including the judgment which the facts immediately

evoke) is particularly unreliable, and something of the causes of honest error. With this knowledge, we are in a position to criticize the testimony offered, and ordinarily we can check it by the accounts given by other witnesses, and, better still, of material facts. For these abide our question better than the transitory processes of the human mind. Much careful research has been performed relating to these problems, but much still remains to be discovered as to the psychology of the witness. With modern experimental methods at our disposal, this is a promising and important field for future research. We may hope that in time there will be provided a body of knowledge that will serve as a more positive and constructive weapon for the criticism and evaluation of evidence than the sceptical outline sketched here. Meanwhile let us remember that the witness is not a mechanical recording apparatus, but an organism reacting to the situation with all the varied fullness of his being. Remember, too, that he has affairs of his own which occupy his thought, and hinder that which is irrelevant to him from bringing him promptly and fully to the alert. To give inaccurate evidence shows neither stupidity nor dishonesty. Any one who lacks sympathy with the eye-witness may be invited to recall all he has seen during the past hour, or to give an account of the contents of the newspaper which he has just put down.

SCIENTIFIC OBSERVATION<sup>1</sup>

WE shall discuss here that type of observation which is exhibited at its best in the work of the scientist. The same skill is, however, important in many other fields of activity. Every one has to exercise it from time to time in matters of daily concern. The detective is equally dependent upon it. The title of this chapter does not mean that we are about to embark upon a study of scientific method, but only that we propose to deal with the systematic perception which is found in its most perfect form in scientific inquiry. The first characteristic of scientific observation is that it is 'disinterested', in the sense that the observer deliberately abstains, to the best of his ability, from mingling any personal valuation into his study of the sensory data. He will have to interpret and judge later, but as he watches or listens his concern is with the sensory fact alone. His purpose is confined for the moment to knowing this group of data, without regard to any practical or intellectual use that his knowledge may subsequently serve. The material that he observes is such that he can examine it at leisure, or if, like some natural phenomena, it is too fleeting for that, he can confidently expect its repetition. He may even be able to bring about a repetition when he desires. The

<sup>1</sup> On the topics of this chapter see Mace *The Psychology of Study* (Methuen's 'Monographs on Philosophy and Psychology'), Chapter II.

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conditions being so favourable, he has no excuse for stopping short of exhaustive knowledge. But his difficulties and his methods vary. In some cases he has to observe a group of static objects, in others to trace the sequence of phenomena, while in others he may find himself reduced nearly to the level of the eyewitness who occupied our last chapter, as when trying to identify a rapidly moving bird.

The typical material has been simply (perhaps too simply) illustrated in Chapter II, and the conclusions which we derived from those examples must be taken into account here. The span of sensory apprehension is of little importance, because successive waves of attention can bring to clearness the whole presented field. Yet the more general process of selection affects observation. Scientific observation always takes place within a definitely limited area. The motives of the selection are obvious in most cases. There are the deep-seated general tendencies, or 'interests', predisposing him to attend to this kind of object or event, and more specific interests (perhaps excited by some recent occurrence) which lead him to attend closely to certain features of the whole, and to adopt a special method of observing them. We usually know in advance what we wish to observe, so that the selection is the result of conscious choice, and guided by some degree of pre-perception. The processes of integration (including confluence) will play their part, but in addition there will be an earnest analysis of what is presented. This will bring about a series of new configurations, and we have seen that it is possible by will to hold a selected figure before consciousness and temporarily exclude its rivals. When the effort is motivated by systematic

curiosity based upon systematic knowledge, this fixation of a particular form is greatly facilitated. Guided by knowledge, the observer seeks actively for relations between the parts, and having discovered them, the internal organization of the object becomes more clear, and the relations of parts to whole more explicit. Supplementation and interpretation necessarily occur at all stages, but the capable observer attempts to hold these processes in check until the first stage of his study is completed. Then the mind's own contribution is allowable and useful, because added consciously. The subjective factor in all knowledge is robbed of its dangers when recognized for what it is.

The pre-perception involved in all scientific observation has nevertheless its risks. In a long series of experiments my subjects were shown pairs of cards, each card being shown for a quarter of a second. Then they had to say whether the second card bore the same design as the first. In most cases the difference, if any, lay in one element only, but there were a few pairs in which the second was totally unlike the first. When the unexpected card was shown after a number of normal experiments, the subjects reported surprise and consequent mental confusion. While immediately recognizing the card as different from the standard one, they could report far less of its details than they could of the others. Further, when the comparison card varied from the standard only by a slight modification of some detail, the difference was generally overlooked, although the detail in question had been properly noted on the first card. The subjects awaited the first exposure with open minds, intent solely on recording the pattern faithfully. They awaited the second with

the expectation that it would either be very similar or at all events belong to a certain family of designs. When this expectation was satisfied there was a tendency to abstain from the effort which had been put forth on the first occasion. When the expectation was frustrated they were in worse case for observing than when they saw the first card, for a mental 'set' had to be released before they could start upon the new object. And this had disappeared.

These results have a direct bearing upon the problem of scientific observation. They warn us that we may miss a rapidly passing event if attention has been pre-directed to something different, and that familiarity with a complex object may blind us to small changes in it. Repetition of the event will provide a remedy for the first of these failures, but not so certainly for the second. Experiment shows that observers often become wedded to some particular mal-perception, and repeat their mistake over and over again. To be aware of this tendency is sufficient for avoiding it. The observer who, taught by his previous errors, has acquired a healthy scepticism as to his perception, will probably detect at once that *something* is different, and it is then a simple matter to detect what the difference is. Repeated observation by different methods, or even with a different mental attitude, will reveal the hidden item.

When an untrained person looks at a slide through a microscope, he usually sees little more than a jumble of patches of colour, which refuse to fall into any coherent or stable pattern. Continued observation reveals additional details without adding to their intelligibility. The general forms of integration operate, but they are not relevant to this unusual

material, and the beginner has as yet no specialized ones available. In order that he may obtain any result at all a certain minimum of knowledge is requisite. He must at least know the general context of the slide, and start with the consciousness that he is to observe a section of a flower, or of an animal's spinal cord. This will not take him very far. He needs further knowledge to enable him to identify some of the details. It is an instructive experience to be shown some complex, and at first meaningless, object of this kind, and while regarding it to hear a key-word. The field at once falls into coherence and becomes flooded with significance. From the first, then, knowledge is requisite for successful observation. From this point onwards directed search and passive regard have an equal place. When checking a watch by the Greenwich time-signal one first actively directs attention to the watch and the sounds, and then passively apprehends the 'pips' and the position of the hands. This rather complicated mental adjustment is common in scientific observation. The observer may be described as looking *at*, and looking *for*, simultaneously. The idea of the pre-selected object to which attention is directed may be of the most fragmentary character. But, however slight the controlling thought may be, the process of attention is directed by it towards the goal of knowing *this* more adequately, and to answering a question about it. This question may be as definite as, 'Is there an X on this slide?' or indefinite as, 'There seems to be something unusual in that part of the slide, what is it?' Thus we find at the outset of the process systematic knowledge and interest, and systematic curiosity.



When this first direction has been secured, the second more passive attention supervenes. This process may be described as one of living very intently through a few moments, so as to 'feel' the experience as keenly as possible. Then thought begins to play upon the material noted, and the observer relates the subordinate parts of the structure to the whole, calls up knowledge relevant thereto, and seeks to organize his results. Unlike the witness of incidents of the world of affairs, the scientist is aware from the first that he will have to testify. Indeed, he would not be busy with his microscope unless he intended to formulate his results in some way, either to inform another person, or only to assist himself to remember what he has seen. Now this intention to formulate the results helps to direct the observation, and to shape it, for it entails a more thorough search for details and order. The most generally useful kind of formulation probably consists in sketching, not so much to obtain a permanent record (the value of which depends upon the person's skill) as that the act of sketching guides attention, and step by step brings to notice features which would have otherwise been overlooked.

The importance of this method is evinced in very varied activities. An experienced and distinguished microscopist has told me that he is never sure that he has seen the contents of a slide until he has sketched it. An artist informed me that he was incapable of appreciating even a simple ornament until he had drawn it. Each of these technically skilled observers had learned the limitations of ordinary perceptual processes, though probably without inquiring into the psychological causes. It may be noted here that,

in addition to guiding vision, sketching brings in another set of sensory impressions—those excited in the muscles taking part in the movement. Knowing the extent to which the blind can employ this sense, we shall understand that sketching must add to the perception of form in this direct way. The principal reason why the direction afforded by the effort to sketch makes so much difference was noted earlier in this book. Our main habits of perception have been formed in satisfying very practical needs. These are in most cases best met by the recognition of an object as a whole, and as a member of a class. It is sufficient to see *a taxi*, without minutely observing its characteristics. The painstaking scrutiny of the scientist and the artist is in a sense unnatural, and runs counter to our normal tendencies. Consequently it needs to be reinforced by a strong purpose, such as is provided by the need of reproduction, whether by drawing or by precise verbal description. The educational significance of this is too plain to require much discussion. We must not expect children to know adequately what is presented to them, whether it be a plant or a map, unless they are required to reproduce it. The sketch may have no value in itself, except to reveal the degree to which observation has been carried, but the effort is all-important.

In some cases, and particularly in nature study, observation means a ready response to very momentary visual or auditory experiences, such as the flight of a bird, or its note. Even here there is a kind of pre-perception. The successful observer is one who is predisposed by training to attend promptly to phenomena of this kind, and who is enabled by his

acquired knowledge to identify what he sees or hears. The importance of knowledge is curiously illustrated by the fact that if one takes the trouble to learn the names of wild flowers he sees more as he walks along a lane. The names serve as directing motives.

After our earlier discussions we shall expect to find that the conditions which favour observation also introduce dangers. Here, as elsewhere, expectation may override presented fact, and preformed theories may blind us by a process of self-persuasion. Even the scientist is prone to see what he hopes to see. The dangers are real enough, but on the whole not grave. Sooner or later error will be revealed. It is more important to note that at the best there are sharp limits to the capacity of the senses. We can never judge identity with absolute precision. On an average we can judge length (provided that no misleading features are present) to about 1 per cent, brightness with about the same degree of precision, and lifted weights to about 3 per cent. But these are only averages, and any one judgment may vary from accuracy by substantially greater amounts. Further, it is always easier to detect the fact of difference than the nature of the difference. We may be sure that two notes are not of precisely the same pitch without knowing which is the higher. Modern scientific methods aim at reducing these limitations by employing instruments to extend the range and accuracy of observation. Particularly admirable are the ingenious methods by which natural events are made to register themselves in a permanent form. So the phenomena of an eclipse are recorded photographically for leisurely observation, in which instruments of precision can be utilized for measurements.

Employing such methods, science justly claims that its results are objective. But no matter what precautions are adopted, and however remote scientific objects may be from ordinary perception (as in modern physics), science remains dependent upon human observation of perceptible facts, and no methods can completely eliminate the intrinsic defects of that factor. The most refined measurements are only true within limits. Just as when we say that a man's stature is six feet we really mean that he is more than five feet eleven, and not more than six feet one, so the scientist who works in units of a hundred-thousandth of an inch can only claim that his measurement is not less than this nor more than that. There is always a margin, and it is an essential aim of science to reduce it to small dimensions, and to estimate the extent to which its results may be vitiated by error.

In the end accurate observation is largely the result of moral qualities. It depends upon honest (and this word should be stressed) effort, and personal failings in this respect will reveal themselves in faulty work. Whether it is possible, and, if so, by what means, to train and foster the development of these qualities, we cannot discuss here. There is no doubt that there are both opportunity and need for training in the use of specialized techniques. For the moral factors require the backing of systematic knowledge. In return, the failure to secure reliable results may induce a conviction of sin, which is the first step to reformation. Thus it may be claimed that a training in scientific method entails an extensive development of personality.

As we have said, observation of the type described

is frequently required in daily life, and it has often been urged that children should be trained to observe. It is obvious that they are very imperfect in the art. I held before a class of sixty or seventy boys (aged about eleven) a book with a white paper band around it. I asked them to draw 'exactly what they saw'. In spite of this explicit instruction about 40 per cent omitted the band. Their attention was called to the omission, and the experiment repeated, the object on this occasion being a box with a pencil protruding from it. Even then 20 per cent ignored the pencil. Another class of small boys, having had a lesson on 'valleys', were asked by me if they had ever seen one. They replied that they had not. Yet a fine stretch of the Thames valley was visible from the class-room window. Nevertheless these boys often observe acutely, so their observation should be termed capricious rather than defective. The problem then arises whether it is possible to even up the powers of observation, and the answer must in the main be negative. This follows from our earlier analysis, and is substantiated by common experience. Observation is not a tool for universal application. The term is really the name of an abstraction. The actual fact is a *person observing*, and what he does and can observe depends upon the individual constitution of his mind. One point only is hopeful: he who has realized the value of accurate observation in one sphere is likely to make an effort elsewhere.

It is questionable whether it would be worth while to develop all-round observation, even if it were possible. The only significant observation is that which is directed to relevant facts, that is, to facts which can be mentally utilized by relating them to

purposes<sup>1</sup> Not all the world is relevant to each of us, we must be content to make a selection, and we shall make the best use of our senses by employing them within our special field of interest, and neglecting the rest Just as elementary perception was made more effective by a balance of concentration and neglect, so at this higher level to learn to ignore is a valuable and necessary art Our sense of values must help us to decide what is profitable to us We shall make mistakes and overlook important facts, but this is the not too heavy price that we must pay for increased efficiency elsewhere What has been called 'sense training' is in fact a branch of intellectual training, and demands selection of material There is a risk that observation, if considered as a process valuable in itself, may degenerate into undirected inquisitiveness The effort is wasted unless it results in valuable knowledge retained and organized The final conclusion is, then, that observation is no isolated process, but an activity of a person, whose simplest act of sense perception expresses in some measure his character

<sup>1</sup> Cf Mace, *The Psychology of Study*, pp 26 and 28

## VI

### A FEW SUGGESTIONS

WE have now studied in outline the processes of sense perception, criticized the validity of the knowledge obtained thereby, and applied the theoretical results of the analysis to a few problems of practical life. It may add to the value of the previous chapters if we now consider some of the directions in which the study might be profitably extended. The most obvious extension would be to study the sensory processes themselves, and one could find occupation for a lifetime in that field. Our experience of colour, simple as it seems, has been found to present many baffling scientific problems, the solution of which would, in many cases, be of practical as well as theoretical interest. In this department research has mainly revealed the complexity and variety of the facts, without as yet yielding generally accepted explanations. Much useful study of colour vision can be carried out with equipment as simple as bits of coloured paper. Those with philosophic leanings can reflect on the fact that about 4 per cent of all men and boys possess a colour sense so restricted that they perceive the world in shades of blue and yellow only.<sup>1</sup> What then is the status of colour in the *real* world?

<sup>1</sup> Theories of colour vision are still so unsettled that the above description of colour blindness would not be accepted by all. It is agreed that the colour-blind perceive only two hues. How little the public knows of this defect was amusingly illustrated when we discovered a colour-blind teacher instructing a colour-blind boy in painting.

The musician will find interest in the study of hearing. This sense submits more readily than vision to systematic treatment, though there are important problems still unsolved. The other senses, and especially touch and kinaesthesia, also provide interesting material for study. A complete theory of perception must take into account the physiological and psychological facts of the elementary sense processes. But there is a great advantage in starting, as we have done, with the more common and more concrete facts of perception before dealing with those very abstract entities called sensations. For it is never merely colour that we see, but always a coloured object, and the hue is thoroughly subordinated to the object in common experiences.

The topics treated of in Chapters II and III will repay much deeper study. Only one or two of the common illusions have been touched upon, and a more extensive study will afford entertainment at least. Then there are the problems inherent in the perception of space and time, the questions raised in this connection being often of very practical interest. For example, they are relevant when investigating the causation of traffic accidents. Ranging more widely, we may endeavour to solve aesthetic questions in the light of the principles we have gathered. One of the characteristics in any acceptable work of art is coherent unity, so we are led to search for the constructive principles which facilitate the mind's integration of artistic material. Aesthetic taste is traditionally regarded as a subjective matter. But the subjective need not be individual and peculiar. There are laws common to all minds. Individuality is due to modification of the common pattern by the



particular circumstances of heredity and environment. It is by the discovery and understanding of the general laws that a science of aesthetics is to be established. Artistic criticism has, in fact, always had a psychological character.

But a still wider extension of our studies is possible. We have considered the human mind only in one of its lower levels of cognitive activity. Unless we have reason to the contrary, we may suppose that the higher levels display the same features as the lower, and that the same laws apply. If this is so, and the available evidence supports the view, we may derive from the study of perception information which is true also of the higher intellectual activities. The latter do not lend themselves readily to experimental methods, and the technical resources of the psychologist are still inadequate for their analysis. So he turns to sensory experience, where he can conduct experiments under exact and controlled conditions. His experiments, as we have said, are often concerned with very unimportant objects, but most scientific experiments appear trivial to those unacquainted with their purpose. The psychologist who spends long periods in the investigation of some simple and artificial illusion is inspired by the belief that the deepest secrets of mental life are as likely to be revealed there as in the most profound thought. Let us glance again at the principles of perception, and, generalizing, see how they bear upon the more highly developed intellectual activities.

In the first place, we shall expect the selective limitation of consciousness to be evinced throughout mental life. Our capacity to hold ideas clearly before us is restricted, and the selection is determined

by the purpose of the moment. Those who cannot maintain this limitation are ineffective thinkers, wandering vaguely from topic to topic. But as the 'ground' told upon the 'figure', so the 'background' of our thought affects and enriches the central current. In perception we overcome the restrictions by organizing the material into a unity, and the same is true of thought. When we employ such richly significant terms as *science*, *Shakespeare's plays*, or *economic development*, we are in some way (not yet thoroughly understood) holding before attention a 'figure' in which the component details are temporarily obliterated. Upon the ability to do this mental progress depends. It is not only unnecessary, it would be disadvantageous, to bring before the mind all the content that any one of those terms implies whenever we had occasion to think of the subject to which it referred. But we are liable to the same type of error here as in the earlier cases. We may be led to overlook important details in the sweep of rapid thought. We are now aware of the risk, and can meet it: our studies have emphasized the value of self-criticism. Next, we may extend the results of the experiments on reading, which we found to involve a hierarchical organization of sensory material. This conclusion can be applied with profit to all study. To learn merely by accumulation is worthless. Unless knowledge is systematically unified it can never be fully available for the solution of new problems.

We saw, too, that unless the presented material was supplemented by the results of previous experience, it was comparatively barren of meaning. So, more generally, it is true that what we can hope to know depends upon what we know already. The existing

content of the mind is brought to bear upon new material, affects it by enriching its meaning, and is itself modified in turn. But this implies that all thought about new information is biased by the thinker's previous experience. The only completely unprejudiced mind is the empty one. Ordinarily we apply the term prejudice only when the subjective factor is abnormally limited and one-sided, and this is a useful restriction of its meaning. It must be recognized, however, that the psychological laws exhibited in the most extravagant prejudice are the same as those operating in the most rational of judgments. It is the determining factors which differ. Now we cannot experiment upon a person's political or religious prejudices, but experiments on sense perception may provide working models. We have seen how figure and ground may exchange roles. When an observer has been shown a number of diagrams consisting of white figures on black grounds he very frequently fails to recognize them on a second exhibition, if he has been led to expect black figures on white grounds. Although the physical objects are identical, a bias or prejudice has been introduced which transforms the object. Is it fanciful to see here a miniature of the processes by which it comes about that two people can draw contradictory conclusions from the same statistics? <sup>1</sup>

Thus the study of 'the evidence of the senses', important enough in itself, illustrates the wider principle that all experience is in part subjective. The mind is never merely receptive, but adds its own

<sup>1</sup> For a discussion of this topic see Field *Prejudice and Impartiality* (Methuen's 'Monographs of Philosophy and Psychology') Compare in particular pp. 22 and 95.

contribution to its experience, and thus helps to make its own history. So we see anew the truth of the adage that each moment is shaping the future. Alike in the most elementary processes of perception and in the highest forms of enjoyment, we discover that what we can extract from life depends upon what we put into it.

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